Finding the adequate legal framework for the deployment of Ocean Renewable Energy through area-based management

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I. Introduction

The world runs on electricity. For the last century, electrification has played a central role in human development, but while the production of electricity has been on the rise for decades, human development is still uneven and incomplete. The lack of access to electricity denies some people the most basic benefits, from healthcare and sanitation to security and economic development. Approximately 1.8 billion people, mostly rural populations in developing coastal countries, still have no access to electricity.1

To increase access to electricity, most developing nations have relied on traditional sources of energy, namely fossil fuels, and the extension of a central electrical grid. This approach has been successful at times,2 but there are at least two limitations: at a certain point, the world will run out of coal, oil, and even natural gas, and the consumption of fossil fuels contributes to climate change.3 Moreover, expanding the central grid into remote, rural areas is expensive and inefficient.4

Scholars and specialized International Organizations suggest that the implementation of renewable energy technologies through small-to-mid scale grid projects could be a reliable alternative.5 However, renewable energy technologies must overcome three formidable hurdles: low reliability, uneven availability, and the high costs of deployment. Ocean Renewable Energy (ORE) technologies, namely offshore wind, wave, tidal, and current energy, may help to solve some of these problems. First, ORE sources are available in any sea or river and coastal regions are those areas of the world experiencing the highest population growth rates.6 Second, the

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3 Aiming to solve this challenge, developed countries suggest global CO2 emission reductions, and a gradual phase-out of carbon-based energy sources, among other measures. Developing countries, however, largely oppose these measures because applying them will lead to a grave disruption of their economic development plans, including electrification
4 Deshmukh, supra note 2, at 2-3.
5 Id.
combination of ORE technologies – e.g. offshore wind and tidal energy, constitutes a highly reliable source of energy, capable of competing with nuclear energy as a baseload7 source.

The problem of high costs remains and is mainly attributable to technical problems. The need to operate in the harsh conditions of the marine environment imposes higher costs on all ORE devices;8 nevertheless some ORE technologies have been successful in reducing costs.9 Offshore wind entrepreneurs have built on the experience and financial strength of the onshore wind industry and have taken the lead in energy developments at sea.10 Currently, the most pressing technical challenge to offshore wind is the need to develop designs for greater depths, which will provide the capacity to build installations in the vast areas of the Exclusive Economic Zone (EEZ), where the winds are stronger and competition with other sea users less intense.11 By contrast, developers of wave and tidal energy started almost from scratch and are still seeking to develop a cost-effective design that can succeed in the market. Wave and tidal energy devices face the additional problem of being in direct contact with the marine environment. Abrasive saltwater and high water pressure significantly reduce the life of ORE turbines.12

All ORE technologies confront significant regulatory barriers. Since ORE developments constitute an unprecedented use of the seas, most nations lack specific regulatory measures, have inconsistent regulatory approaches, or find their legal frameworks unprepared for the development of ORE technologies. All of these difficulties lead to excessive delays, reduced economic feasibility, and a dilution of public support and private investment. In other words, a fraction of the high costs of most ORE technologies is attributable to inadequate regulations.13

Scholars exploring the regulatory challenges to ORE development have focused on topics such as the regulation of hydrokinetic projects,14 safety issues related to the development of

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7 “Baseload power” producers are defined as power plants that “can run virtually without interruption to supply the continuous portion of a company’s needs, as compared to the needs that expand and contract seasonally or diurnally” FRED BOSSELMAN ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT 1010 (2010).
8 ORE devices need to be installed in water areas where the wind is high the waves are strong; and tidal currents allow for very short periods of installation activities. Besides, maintenance operations are costly. Offshore installations need specialized service vessels, airborne transportation of personnel, and the construction of special installations. An additional problem these technologies are facing is the lack of accurate information on the availability of the resource, particularly for wave and tidal energy. See IEA-RETD, OFFSHORE RENEWABLE ENERGY: ACCELERATING THE DEPLOYMENT OF OFFSHORE WIND, TIDAL AND WAVE TECHNOLOGIES 96-99 (2012).
10 The first offshore turbines where merely onshore designs placed on water. It was only until recently that of developers started building offshore of wind turbines specifically designed for offshore wind, but basically they all follow the same design of the original Danish design for onshore wind turbines. See EIA-RETD supra note 8, at 99.
11 Id.
12 See Beaudoin et al., Technological challenges to commercial scale application of marine renewables, 23 OCEANOGRAPHY 32, 36 (2010).
14 Jon Wellnighoff et al, Facilitating hydrokinetic energy development through regulatory innovation. 29(2) ENER. L. J. 397, 397-420 (2008).
offshore renewable energy, the feasibility of hydrokinetic energy for least developed countries, the balance between federal and state competences, and the administrative loopholes that impose excessive permit requirements for pilot projects. Less attention has been paid to other equally important factors, such as regulations for allocating seabed rights and marine spaces for the research and deployment of ORE technology.

This article is the first to analyze these regulatory problems and focuses exclusively on space allocation by assessing the legal instruments used to allocate space and the outcome achieved. Although some regulations have obtained moderate success, there is a long list of failures. ORE technologies are developing slowly; in a few countries, and with offshore wind being the only technology developing utility-scale projects.

Comparative legal studies may frequently be taken with a grain of salt, since domestic regulations are typically the result of local circumstances and compromises. What works in State A may not work in State B. Even with this caveat, this article finds that ORE technologies are developing faster in nations that have implemented some form of area-based management. Although this regulatory approach has several limitations, the area-based model is providing increased policy support and legal certainty to small-and-large scale ORE investors. Experience in ocean management indicates that, as new uses of the seas are made available, ocean space allocation becomes an increasingly controversial issue, demanding the attention of regulators and policymakers alike. Aiming to confront this problem, proponents of area-based management suggest that managing areas of the seas in order to prioritize a series of uses can be more effective than the non-spatial approach.

15 Robert Cinq-Mars, Challenges in regulating the Open-Ocean Energy Industry. Assessing engineering and regulatory gaps for wave and current energy installations in the Outer Continental Shelf, 50 SEA TECHNOLOGY 9, 10 (2009); 16 Veronica B. Miller et al, Hydrokinetic power for energy access in rural Ghana, 36 (2) RENEWABLE ENERGY 671-675 (2011). 17 Mark Sherman, Wave New World: Promoting Ocean Wave Energy Development Through Federal-State Coordination and Streamlined Licensing, 39 ENVT’L L. 4 1161-1224 (2009). 18 So far, most of the literature analyzing regulation for ORE have focused on describing the difficulties of competing against traditional sources of energy—e.g. capture by concentrated interests—and the use and abuse of subsidies. Regulations have created research institutions and provided special feed-in tariffs for new technologies. Perhaps surprisingly, for the majority of these regulations, the availability of ocean space exclusively dedicated to research, this is marine areas where to install and test devices, seems a secondary issue. For example, in 2006 the German federal government created the Renewable energy foundation (per law xxx, but it did not assign a specific marine area for it. Only after “the foundation” won a bid on an offshore area, could they begin testing their offshore windmill prototypes. This article seeks to answer a very specific question: how nations regulate the use of their maritime spaces for purposes of ORE technology research and development. 19 E.g., creating exclusive access privileges for ORE activities, excluding other uses, and providing long-term support for the development of these technologies. 20 For example lack of adequate information on the marine environment farther offshore, or monitoring and enforcement problems. These will be explained in detail later. See, e.g., Kit Hawkings et al., Managing Regulatory and Consenting Costs for Offshore Wind 39, http://www.renewableuk.com/en/publications/reports.cfm/managing-regulatory-consenting-costs-offshore-wind
Section II of this article presents an overview of the problem of lack of access to electricity, explaining why renewable energy technologies are being considered as solutions. It also summarizes the basic principles and current developments of the three major ORE technologies, and explains potential regulatory advantages of ORE development. Section III describes the “bottom-up” and “top-down” approaches to regulation for ORE technology, analyzing the regulatory frameworks of three countries that have used area-based management mechanisms for ORE deployment. It also looks at the specific case of regulating ORE technology research. Finally, Section IV assesses what the future holds for ORE regulation, and suggests that coastal nations interested in developing their marine energy potential could learn from experiences that use a spatial approach to the management of large-scale renewable energy projects, such as the Solar Energy Zones (SEZs) that have been created in the American Southwest.

II. Understanding the role of ORE.

Seeking to provide a higher quality of life to their citizens, many developing nations have centralized the generation of electricity by expanding their central grids, and have relied on traditional sources of energy such as fossil fuels to do so. Although this approach has led to a significant expansion of available electricity in some regions of the world such as China or Latin America, it has come at the cost of increased CO2 emissions which worsen the problem of climate change.

In terms of policy, there is a fundamental gap in the search for sustainable development: on the one hand, we need to expand electrification to guarantee certain basic human needs. On the other hand, we need to reduce fossil fuel consumption, and this diminishes the number of options many countries have to achieve universal electrification. This dilemma remains unsolved. Meanwhile, 1.8 billion humans in the developing world still have no access to electricity, and the effects of climate change keep worsening.21

The sustainability of the global environment is threatened by the significant increase of CO2 emissions in developing nations. Although many international actors recognize the role of renewable sources of energy in achieving sustainable global growth,22 the contribution of renewables to energy generation is still limited, with much room for improvement.

It has been assumed that developing countries should not invest in renewable energy due to high costs and the belief that these countries were less concerned with the negative consequences of pollution and other environmental problems. This situation has changed. Today, onshore wind energy is already cost competitive and cheaper than coal or oil electricity plants in terms of “levelized cost of electricity,” a term used to estimate the costs of electricity production

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discounting the externalized costs—such as subsidies, human health risks, or environmental damage. Offshore wind energy and other non-fossil fuel technologies have been gradually reducing their production costs. Developing economies, including India and China, are leading energy growth and investing in renewable energy research. China’s recently reformed environmental protection statute sets the “sustainable production of energy” as one of its primary goals. However, these efforts and those of other major world energy consumers are still not enough to avoid the potentially catastrophic consequences of climate change. In order to comply with the recommendations of the Intergovernmental Panel on Climate Change (IPCC), global support for renewable sources of energy must increase.

In addition to funding and political support, renewable energy developers need an adequate legal framework for their projects. Given the range of technologies which is available for renewable energy, policymakers are faced with important regulatory choices.

a. Renewable energy options: the promise of Ocean energy (ORE)

The need to promote a transition to renewable energy sources has not considered ORE technologies as a first priority. When climate change became a relevant topic for most nations, ORE technologies were still in their infancy, and the focus was on more mature technologies such as inland wind and solar energy, or in stream hydrokinetic energy. In the last thirty years however, there have been significant technical advances in ORE technologies. Offshore wind energy is already a cost effective energy alternative, and other ORE technologies are now much closer to reliable designs. The maturity of ORE technologies puts them in a position to be significant contributors to the global transition to clean energy sources. There are several reasons for this change; the first is wide availability and proximity to large populations. About 65% of the world’s cities of over 5 million people are located in coastal areas. In China, the population in these areas

23 The LCOE of a given technology is the ratio of lifetime costs to lifetime electricity generation, both of which are discounted back to a common year using a discount rate that reflects the average cost of capital. IRENA, costs of renewable energy report 2014, at 12, http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Power_Costs_2014_report.pdf

24 Id., See also at 52-55.


28 See, e.g., IPCC supra note 21 at 82.

grew at twice the rate of the national growth between 1990 and 2000.\textsuperscript{30} Second, most ORE technologies have the capacity to adapt and to combine with each other. Devices combining the exploitation of, e.g., offshore wind and tidal energy, will provide an inexhaustible and reliable source of energy. However, all ORE technologies still face several technological challenges.

The following paragraphs summarize the working principles and technical designs of the three most relevant ORE sources: offshore wind, wave energy, and tidal energy.

i. Offshore wind

The renewable energy sector is booming worldwide\textsuperscript{31} and offshore wind is a major contributor. Among the myriad potential uses of the oceans, projects for renewable energy generation have been gaining momentum, in part thanks to the efforts carried out by the wind energy industry.\textsuperscript{32} Even in the midst of a global economic downturn, investment in renewable energy has steadily increased, reaching 269 billion dollars worldwide in 2013, five times greater than in 2004.\textsuperscript{33}

Wind energy is closely linked to solar energy. Solar radiation on the surface of the earth causes temperature differences and generates the movement of air masses. While friction with geographic structures slows down wind, this friction is very low in open waters.\textsuperscript{34} Offshore wind and tidal energy projects provide higher reliability than inland wind and solar.\textsuperscript{35} On the other hand, the particular conditions of ocean spaces make it technologically difficult -- and therefore more expensive -- to build and manage any kind of structure or installation in the open seas.

Wind turbines convert the kinetic energy of wind into electrical energy. Although several designs were tested, the one that has dominated the market is the classic three bladed horizontal axis wind turbine. The wind passing through the blades horizontally moves the wings of the
turbine. Inside the nacelle, this movement is transferred to a gearbox, which increases the slow rotation of the blades and is then connected to an electrical generator that converts the kinetic energy into electrical energy. See Figure 1 for a schematic of an offshore wind turbine.

Figure 1. Schematic of an offshore wind turbine

Wind energy has been used for centuries, but it was only in the 1990s that technical developments made it possible to develop the first offshore wind projects. Several EU Member States and China have engaged in significant investments to develop utility-scale offshore windfarms.37

Offshore wind in shallow waters is the most developed, tried, and tested of all ORE technologies, and plans for new developments are ambitious in the European Union. Deep water (more than 500 m.) designs, on the other hand, still face significant technical problems, and no large-scale developments are expected to be constructed before 2020.38

ii. Wave energy

The wind blowing over the surface of the water creates waves, which receive part of the wind energy, constituting a concentrated form of wind energy.39 Resources of wave energy have been estimated between 2000 and 4000 twh/year worldwide.40

Technologies for harnessing offshore wave energy are varied, ranging from point absorbers to attenuators and oscillating water column devices.41 Unlike wind energy, no single design of a wave-energy turbine has become predominant in the market. Although the purpose of all the devices is the same, i.e. transforming the kinetic energy of waves into electric energy, the working

36 Modified by the author from a graph at www.ewea.org
39 IEA supra note 8, at 6.
40 Id.
41 For a detailed account of the broad range of wave energy designs and devices see OCEAN ENERGY SYSTEMS, The Development of Wave Energy Utilization, http://www.ocean-energy-systems.org/what-is-ocean-energy/waves/ (last visited March 20th, 2015).
principles of the designs are different. Point absorbers, attenuators and overtopping are the most relevant wave energy technologies for area-based management and ocean zoning.\textsuperscript{42}

Point absorbers (see Figure 2 a) are buoys located on the surface of the sea or in the water column. The buoy moves up and down, aided by the motion of the waves, and is connected to a generator, which converts this kinetic energy into electrical energy.

\textbf{Figure 2}\textsuperscript{43}

Wave energy attenuators (Figure 2 b) are snakelike devices located on the surface of the sea. Surface attenuators usually find their optimal operating conditions in waters approximately 50 to 70m in depth. Attenuators face particularly difficult technical problems, since they are composed of many different movable parts and are more exposed to rough seas.\textsuperscript{44}

Overtopping devices (Figure 2 c) are wave energy converters that generate electricity by collecting water from the waves into a reservoir. The reservoir then drains through a conventional hydraulic turbine which converts the kinetic energy into electricity.

\textbf{iii. Tidal energy}

Tidal and ocean current energy turbines are designed to generate electricity by extracting the kinetic energy from both the ebb and flood cycles.\textsuperscript{45} Tidal energy devices convert the kinetic energy of the flowing water of the currents into motion, which is then converted into electrical energy by a generator. There are currently three different designs for tidal energy devices: horizontal axis, vertical axis, and cross flow (see Figure 3). Tidal energy represents a new approach

\textsuperscript{42} Additional technologies for wave energy are either exclusively or principally shore-based, and are not considered in this article. See generally António F. de O. Falcão, \textit{Wave energy utilization: A review of the technologies} 14 RENEWABLE AND SUSTAINABLE ENERGY REVIEWS 899 (2010).


\textsuperscript{44} See, e.g., EIA-RETD supra note 8, at 24 (citing problems experienced by the Pelamis pilot project off the Portuguese coast in 2008).

\textsuperscript{45} IPCC, \textit{Special Report on Renewable Energy Sources and Climate Change Mitigation} final release (2012), \texttt{http://srren.ipcc-wg3.de} (explaining that this constitutes the main difference between tidal energy devices for in-stream rivers and those designed to be placed in the open water of the sea).
to energy generation— the first prototypes were only developed about 15 years ago. At present, several tidal technologies are being developed but, as in the case of wave energy, no single technological design has become predominant.

Fig. 3 a) Horizontal axis turbine b) Vertical axis turbine c) Cross flow turbine

ORE technologies feature some technical advantages compared to other renewable energy sources:

First, ORE technologies are the most reliable of all renewable energy sources. Ocean currents will be available as long as the world keeps spinning, and the same can be said for the ebb and flow movement of tides. Tides are highly predictable, which means that utilities featuring tidal energy turbines know exactly when the sea water will stop moving inland or start flowing offshore and can plan their activities accordingly. This constitutes a great advantage compared to other, less predictable sources of renewable energy, such as sun or wind. The latest technological developments seek to combine tidal, wind, and wave energy converters. Turbines tapping these combined resources would provide constant, environmentally friendly, and inexhaustible electric energy.

These sources of energy are also widely available in coastal areas throughout the world. These regions are experiencing the highest rates of population growth. These coastal areas are also the places where demand for electricity is likely to increase in the next few decades. Although

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46 However, it must be noted that some current technological developments found inspiration in old ideas about energy conversion. A good example of this is the Pelamis wave generator, which is inspired in a late 1890’s design by F. O. Rusling. For a brief comparison of both designs, see Robert Cinq-Mars, Challenges in regulating the open ocean energy industry. Assessing engineering and regulatory gaps for wave and current energy installations on the outer continental shelf. SEA TECHNOLOGY MAGAZINE 11 (September 2009).
47 Bahaj, supra note 3, at 5.
48 At least 40 different tidal power technologies are currently being developed, mostly in Europe and the United States. A list of developers may be found in JACK HARDISTY, THE ANALYSIS OF TIDAL STREAM POWER 90 (2009). The US Department of Energy keeps an updated database of several ocean renewable energy research projects being developed around the world. The database may be accessed at: http://www1.eere.energy.gov/water/hydrokinetic/default.aspx (last visited March 20th, 2015).
49 Graphics from OES supra note 43, modified by the author.
there are still significant challenges in the development of ORE technologies, developers have been improving the performance and costs of designs at a remarkable pace, and technological tipping points such as the development of floating wind turbines, and a reliable tidal energy turbine are expected to be reached before the end of the present decade. ORE developers require a regulatory framework that promotes and facilitates the deployment of their devices.

b. Regulating renewable energy: the advantages of ORE.

ORE technologies present, at least in theory, three advantages that reduce the complex regulation one would expect in large-scale energy development. First, ORE technologies are less likely to be affected by Not In My Back Yard (NIMBY) movements than other utility-scale projects. NIMBY movements constitute one of the most significant burdens to large renewable energy projects inland. Local movements have organized to stop projects, causing significant delays or cancellation. Although ORE projects are not free from strong opposition under certain circumstances, this is less likely to happen. The visual impact of wind farms has been one of the main drivers of inland NIMBY movements, but tidal energy turbines and several wave energy technologies are submerged and thus have no visual impact. Wave energy converters that need to be placed on the surface of the sea have a minimal impact on the seascape. While wind farms have been by far the most controversial in terms of their effect on the landscape, NIMBY conflicts involving offshore windfarms are less likely to occur as technology allows wind turbines to be located farther offshore.

Second, in many countries, regulations for ocean resources management are the exclusive competence of the central or federal government. Thus, although regulatory frameworks are still challenging for ORE developers, they are less likely to have to comply with regulatory measures imposed by two, three or four different levels of government. The management of human activities on the Exclusive Economic Zone (EEZ) is a good example. The EEZ, a recently created area of national sovereignty, is not affected by local customary norms, vested rights, or most “devolution” initiatives. The fewer regulatory bodies involved in the process means fewer regulatory steps required for ORE developments.

50 See, e.g., IEA-REDT supra note 8 at 96-99.
51 OES supra note 43, at 46.
52 Id.
53 The offshore wind industry can account for a few famous NIMBY movements of its own, such as the Cape Wind Project in Massachusetts. NIMBY movements against wind energy projects have led to cancellation of large projects also in the developing world. See, e.g., Oaxaca: Mareña Renewables to cancel wind-energy project in San Dionisio del Mar, https://sipazen.wordpress.com/2014/01/15/oaxaca-marena-renewables-to-cancel-wind-energy-project-in-san-dionisio-del-mar/ (last visited March 20th, 2015).
55 Transferring federal responsibilities to the states and counties. See, e.g., Edward J. Martin, Reexamining Devolution, 33 PUBLIC ADMINISTRATION QUARTERLY 635 (2009).
Finally, operating conditions are extremely difficult further offshore, reducing the number of uses and users of the EEZ. The size of the EEZ allows users with competing interests to operate without interfering with each other’s activities. In order to install wind turbines or solar panels, inland renewable energy projects need to obtain property or use rights over large areas. Nevertheless, inland space is very limited and competition with other uses is strong. Land areas presenting the ideal conditions for wind or solar projects are scarce. While this might not constitute a problem of first order for large countries such as the U.S., it is a major problem for renewable energy entrepreneurs in smaller nations. Moreover, utility-scale projects inland need to be granted the exclusive use of the area to be developed, and few other uses may be possible in that same land area. This may be politically difficult for government officials and policymakers, increasing regulatory uncertainty for investment. ORE projects, on the other hand, benefit from the virtually infinite availability of space at sea. Those ORE technologies less compatible with other uses, such as utility-scale offshore wind projects, may be developed in the EEZ without affecting marine traffic or coastal tourism, and with a very limited impact on fisheries. Tidal energy turbines, which need to be placed at very specific locations closer to the shore, are compatible with navigation and tourism, the other most common uses in shore areas.

All of these characteristics suggest that, at least in theory, regulating ORE developments should not be the most challenging task, practice shows that regulations constitute a headache for ORE developers and investors.

III. Regulating ORE projects: the bottom-up and top-down regulatory approaches.

Not all hurdles to the development of ORE are the result of a lack of technological maturity. Inadequate regulatory frameworks pose non-technical barriers to effective ORE deployment. Specific regulatory problems include lack of coordination between local and central governments, inconsistent policies, unclear permitting pathways, or a regulator’s lack of experience.56

Although each nation has had its own approach to the regulation of ORE, regulation of ORE projects has centered around legal issues in two areas. The first requirement is to obtain operating permits and leases of ocean and/or seabed space for the installation of energy devices. After permits are granted, it may be necessary to obtain additional leases and easements for permitted activities.

Operating permits or licenses usually relate to two activities: permits for electrical generation and permits to conduct activities on the state-owned territorial sea and EEZ. The requirements for obtaining permits are administered by agencies overseeing environmental protection,57 navigation, coastal management, and electrical regulation.

In order to develop an ORE project, the developer, in addition to required permits, must hold valid title to the marine space. The most common legal form used for this purpose is a lease

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56 IEA-RETD, supra note 8 at 155-57.
of seabed space. Valid title is a critical element in the development of an ORE project. Defective title or clouds on title can result in significant losses or even cancelation of the project. The projects also need to have rights-of-way to lay cables and power lines to connect the offshore turbines to the electrical grid.

In allocating the exclusive rights to use in ocean spaces for ORE development, agencies or commissions have adopted one of two broad approaches to regulation:

- **Bottom-up approach:** The developer proposes a marine area suitable for ORE, and will then contact all agencies with jurisdiction over ocean management to obtain all necessary permits or authorizations.

- **Top-down approach:** The government, often in collaboration with the industry, conducts an area-based assessment of the waters under its jurisdiction to identify sites suitable for ORE. Once these areas have been identified, the agencies initiate a call for tenders, awarding the site to the highest bidder.

Figure 4 provides a graphical representation of this regulatory landscape.

The vast majority of states still follow the bottom-up model in regulating ORE development. This means that ORE developers need to engage in several rounds of permitting and approvals, e.g., for environmental protection, safety of navigation, allocation of seabed rights, or

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**Figure 4.**

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<td>permits of operation</td>
<td>Leases and/or concessions</td>
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<td>Regulatory approaches</td>
<td>Bottom-up</td>
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coastal management. Given the predominant role that users have under this traditional approach it is referred to here as the "bottom-up" approach to ORE management.

More recently, and motivated in part by their interest in promoting the development of ORE, a few states have engaged in large-scale area-based management assessments. Area-based ocean resources theory argues that managing ocean areas in order to prioritize one or several uses can provide a more effective exploitation of the ocean resources than the “bottom-up” approach. Implementing a comprehensive system of area-based management requires planning and zoning. The process of marine spatial planning involves assessing ocean resources as well as current and future uses; identifying compatible and incompatible sets of uses; and developing a spatial plan that proposes types and locations of various management areas. After the plan has been developed, the ocean zoning process translates the marine spatial plan into enforceable legal rules. This alternative regulatory model, with the government as planner, is referred to as the “top-down” approach.

a. The bottom-up approach to ORE regulation.

Regulations for ORE development in most nations present similar conditions. Seeking to promote energy security and the development of new sources of electricity, many governments have created research institutes and public-private partnerships for ORE, established national goals, renewable energy funds, and technological foundations. Some legislatures have enacted regulations promoting the development of ORE and other renewable energy technologies. In most cases, however, these regulations give governmental agencies a broad mandate to develop technology for ORE, but they do so while providing little guidance on how to achieve this goal. Just like private companies and investors, most of the agencies that receive the mandate to promote and enhance ORE development find themselves with inadequate regulatory tools to conduct the most significant part of the research process, namely putting devices in the water. Agencies are given the responsibility to promote ORE, but at the same time they still need to comply with other priorities, such as ensuring environmental protection or sustainable fisheries. The resulting permitting process for ORE projects is usually complex and time consuming, and although agencies in some nations guide developers through permitting, coordination in most cases is difficult.

Under the “bottom-up” approach, every human use of the seas is regulated independently, from vessel routing and aquaculture to fisheries and oil and gas exploitation. This approach multiplies the number of statutes and governmental agencies regulating the new activity. As the new activity becomes more widely used, governments respond by enacting specific statutes and/or by creating a specialized management body. Indeed, states that follow the bottom-up approach present different regulatory structures and policies. Regulations for ORE in these states fall into

58 See, e.g. the creation of the Stiftung Offshore Windenergie (German Offshore Wind Energy Foundation), which has become a significant driver of investment on offshore energy in Germany, http://www.offshore-stiftung.de/ (last visited March 20th, 2015)
59 OES supra note 9, at 2.
60 Id.
61 Id. at 42.
one of three categories: a) absence of specific ORE regulation, b) ORE regulation enacted without agency guidance, and c) ORE regulation complemented by agency guidance – e.g. streamlined processes or one-stop-shops (see Fig. 5).

First, the bottom-up approach exists in coastal states that have not enacted any specific legislation to regulate ORE. As technological inventions allow for new uses of the oceans, regulatory bodies generally approach the issue by analogy – e.g. applying existing regulation of the most similar activity to the new use. This situation creates regulatory uncertainty and leads to delays, since developers do not know exactly what regulations apply to them and which agencies govern them. This is the case of regulation for ORE investments in Mexico. Since no ORE projects have been developed in Mexico, the country lacks specific ORE deployment regulations. In these cases ORE investors usually take the initiative and contact the regulatory authorities for advice on the regulatory steps that must be followed.

Figure 5

In some cases though, repeated contacts between management agencies and entrepreneurs lead to the enactment of specific regulations for ORE. The procedures for licensing an ORE project in Spain exemplifies this second stage of the bottom-up approach:

Researchers and developers of any kind of marine renewable energy technology in Spain need to fulfill the requirements of the following regulations. Royal Decree 1028 of July, 2007 establishes a series of procedures to apply for a permit for electricity generation at sea. The Decree determines that certain geographical areas of the Spanish coast are restricted for marine energy installations, since marine energy activities are considered to be incompatible with wildlife conservation. An ocean energy developer needs to apply the Ministry of Industry for authorization for electricity generation. At the same time, the developer must apply to the Ministry of the Environment for a concession of the maritime public domain. The Ministry of the Environment is
also in charge of revising the environmental assessments for the proposed activity. In addition, an authorization must be obtained from the Merchant Shipping Directory General, a specialized agency in charge of authorizing all activities that may affect safety and navigation. The Ministry of the Environment will also provide for measures for the restoration of fish resources. Finally, the investment must be done in compliance with the requirements of all other administrations including regional and local regulatory bodies. These requirements apply equally to utility-scale investments and small-scale research pilot projects.

Third, some states have created streamlined permitting processes or “one-stop-shops” for ORE projects that fulfill a series of requirements. Although these experiences are within the bottom-up approach, nations featuring one-stop-shop procedures have gone further that developing specific regulations for ORE.

ORE regulation in Denmark exemplifies this approach. Both the Danish Energy Agency and the Danish Environmental Agency share authority over ORE projects. The Energy Agency opens calls for tenders to develop specific sites, which are determined by the Agency after conducting its own studies. Private investors may also apply for permits in areas not listed (the so-called “open door” procedure), but these are spaces not designated for offshore energy projects. Environmental Impact Assessments for ORE projects are performed on a case-by-case basis.

In order to obtain the necessary leases and permits, ORE developers need to apply to both agencies. However, the agencies have agreed that the Energy Agency is the leading agency for the approval process for ocean energy. The Energy Agency has issued guidelines to help developers meet the regulatory requirements. Although all ORE projects are required to follow a public consultation projects, these requirements are less stringent for those ORE developments that do not have a visual impact.

Recently, Denmark has initiated a partial area-based management assessment that implements MSP for assessing potential sites for offshore wind development. However, MSP is only used as a decision-making tool, and no zoning has been implemented to date. Other ORE technologies have not yet been considered in the area-based process.

b. The top-down approach to ORE regulation: area-based ocean management.

An increasing number of countries in both the developed and developing worlds are embracing the concept of spatial or area-based management of ocean resources. Nations big and small, from Canada and China, to Denmark, Scotland, and Belgium, have developed Marine Spatial Planning (MSP) for their territorial waters and/or Exclusive Economic Zone (EEZ).

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62 OES, supra note 9, at 20-21.
63 OES supra note 9, at 37.
64 Id. at 31.
65 Id. at 13.
Although the use of spatial management has been regarded as a new tool for the implementation of Ecosystem-Based Management, the idea of zoning the seas predates the ecosystem approach. Zoning was not envisioned as a means to ensure protection of the environment but rather as a strategy to organize the varied uses of the ocean and its resources. In the last two decades, environmental advocates have promoted area-based management for the creation of Marine Protected Areas (MPAs). Current governmental support for area-based regulation at sea has been driven by increasing interest in the development of ORE technologies, in particular offshore wind.

Not all human uses of the sea have a geographically identifiable impact, but the most significant economic activities tend to have a spatially-defined footprint. Wind farms, harbors, offshore wind parks, and nature protection areas, are all marine activities that are area-based. Some uses are incompatible, leading to conflicts between users who insist upon conducting their activities in areas with other users. In this situation, an area-based study developing updated maps that define present distribution of human uses of the sea is an effective policy to avoid conflicts between users and, at the same time, to prepare for new uses and mitigate future conflicts.

Apart from affecting each other, human uses of the sea also affect the marine environment. Area-based management has been designed not only to order the human uses of the sea, but also to ensure the effective protection of marine wildlife. As have stated earlier, one of the limitations of the bottom-up approach is that environmental impact assessments performed on a case-by-case basis cannot take full account of the impact of human activities on the marine environment. In contrast, an area-based management approach allows for a large scale planning that takes into consideration the impacts of all current and future projects in a spatially-defined area.

Some nations have embraced the concept of MSP and are in the process of developing MSP assessments. Others countries have established MSP as a general rule supporting the decision-making of agencies which regulate ocean management. Still others have gone further and created specific area-based regulation through Ocean Zoning. MSP is an information-gathering process which, by providing increased knowledge on the conditions of the marine environment, helps management agencies make better regulatory decisions.

OZ goes a step further, building on the information obtained through the MSP process, to create a zoning plan that legally divides marine uses. Again, as with the bottom-up approach,

67 See Morgan Gopnik, What Regional Ocean Planners Can Learn from U.S. Public Lands Management, 6 SEA GRANT LAW AND POLICY JOURNAL 46, 47-8 (2013-14)
68 This is the case of several national marine planning assessments such as the ones developed by the Netherlands, Denmark, the United Kingdom, Germany, and Canada. See generally, Stephen Jay et al., International Progress in Marine Spatial Planning, Ocean Yearbook 27 171 (2013).
69 Ehler & Douvere supra note 66, at 57.
nations are at different stages of development and implementation of the top-down approach to space allocation. These stages might be summarized as: a) regulations transitioning from the bottom-up to the top-down model, b) partial implementation of MSP, c) MSP with partial use of OZ, and d) comprehensive OZ (see Fig. 6).

Figure 6

In some cases, nations have embraced the area-based management approach but are still in the process of defining the role this methodology must have in the regulatory process. For instance, ORE regulation in the U.S. exemplifies a regulatory framework that has been gradually transitioning from the bottom-up to the top-down approach, although this transition is still incomplete. The lack of a clear regulatory process made it more difficult to develop the first utility-scale offshore wind farms in U.S. waters. At the federal level, several regulatory agencies asserted jurisdiction over offshore wind projects. Both the Federal Electricity Regulatory Commission and the Bureau of Ocean Energy Management considered themselves the lead regulatory agency on the matter. At the same time, developers had to engage in regulatory processes managed by other federal agencies, such as the Environmental Protection Agency (EPA) and the U.S. Corps of Engineers (USCOE). In addition, offshore wind projects need to comply with state and local regulations.
The Cape Wind project, the first offshore wind project in the US, was confronted with several layers of overlapping and at times conflicting agency decisions. The developer had to deal with hundreds of government agents and participate in protracted litigation, resulting in construction delays and increased costs for the developer and the agencies involved.\textsuperscript{71} Although the project was designed to provide clean energy, and thus contribute to climate change mitigation, some of the lawsuits against the Cape Wind project were brought by environmentalist groups. The project was also opposed by government agencies involved with national security, air traffic control, and marine navigation. Finally, interest groups, ranging from local residents, historical preservationists and Native American joined the opposition. After fourteen years, construction has yet to begin on the Cape Wind project.

Inspired in part by the fiasco of the Cape Wind project, the U.S. government issued a National Ocean Policy (2013) to promote regulatory reform of ocean management. The National Ocean Policy mandates the implementation of Coastal and Marine Spatial Planning (CMSP), an area-based process for analyzing ocean uses and identifying priority areas for each use.\textsuperscript{72}

Despite being presented as a policy reform aimed at resolving and avoiding conflicts between users of the seas, critics of the CMSP claim that, instead of establishing priority or dominant use areas in the distribution of uses at sea, CMSP manages most sea areas as multiple-use zones, marine spaces where several uses can be performed simultaneously.\textsuperscript{73} This approach may provide regulators with more information on the conditions of the marine environment. However, most countries implementing an area-based approach to ORE regulation have gone further and created exclusive use zones, marine areas that may only be used for the purpose of installing ORE devices and its related facilities.

The United Kingdom, for instance, has employed an area-based assessment for regulatory reform in the management of its ocean resources. The UK’s 2011 Renewable Energy Road Map set out ambitious commitments for the installation of ORE technologies, and established an OZ plan for the purposes of renewable energy generation.\textsuperscript{74} About half of the world’s installed offshore wind capacity is currently located in UK waters.\textsuperscript{75}

\textsuperscript{71} See Tom Zeller Jr., Cape Wind: Regulation, Litigation And The Struggle To Develop Offshore Wind Power In The U.S, \url{http://www.huffingtonpost.com/2013/02/23/cape-wind-regulation-liti_n_2736008.html} (last visited March 20th, 2015)
\textsuperscript{72} COUNCIL ON ENVTL. QUALITY, FINAL RECOMMENDATIONS OF THE INTERAGENCY OCEAN POLICY TASK FORCE 41 (2010), available at \url{http://www.whitehouse.gov/files/documents/OPTF_FinalRecs.pdf}
\textsuperscript{73} Josh Eagle, Complex and Murky Spatial Planning, 28 J. LAND USE & ENVTL. L. 35, 36-37 (2012-2013).
\textsuperscript{75} This situation is likely to change in the near future, as new offshore wind farms currently under construction in Germany start operating. \textit{See e.g. EWEA scenarios for 2020,} \url{http://www.ewea.org/publications/reports/wind-energy-scenarios-for-2020/}
The Energy Act of 2004 created the concept of Renewable Energy Zones (REZ) in UK Waters.\textsuperscript{76} The regulations established by the Act include procedures for licensing energy production projects in the zones, and transmission licenses.\textsuperscript{77} The Act also streamlines the permitting process for renewable energy projects proposed within the boundaries of the REZ are to be streamlined.\textsuperscript{78} REZs have been created in three rounds; however, only the last round was based in an area-based assessment (see the location of UK REZs in Fig. 7).

Figure 7\textsuperscript{79}

Complementing previous legislation, the Marine and Coastal Access Act of 2009 introduced MSP management and established a comprehensive licensing scheme for all activities,\textsuperscript{80} including renewable energy, carried out in marine areas. The Act also transfers most permitting competences—including those for offshore energy projects contained in the 2004 Energy Act- to the newly-created Marine Management Organisation (MMO).\textsuperscript{81} While the drafting was intended as a unitary effort, implementation has been left to regional administrative bodies.\textsuperscript{82} Consequently, the MMO directly manages the waters of England and Wales, while Marine Scotland administers Scottish waters, and the Department of the Environment issues licenses for

\textsuperscript{77} Id.
\textsuperscript{79} See UK Government, supra note 74, at 43.
\textsuperscript{80} S. Jay, Mobilising for marine wind energy in the United Kingdom, 39 ENERGY POLICY 4125 (2011).
\textsuperscript{82} Stephen Jay et al., International Progress in Marine Spatial Planning, 27 OCEAN Y.B. 171, 195 (2013).
energy projects in Northern Irish waters. These agencies also ensure that Environmental Impact Assessments are conducted for all ORE projects.

The approach followed by the UK consisted in conducting MSP assessments and then using the information obtained to create specific zones for ORE. Other nations have enhanced the scope of the top-down method by creating zones for a variety of activities, such as fishing, shipping, or environmental conservation. The Royal Decree of 11 April 2012 established a zoning mechanism for the Belgian section of the North Sea. Article 8 specifically defines a zone for “generating electricity from water, tides or wind.” Within this area, energy projects take precedence over any other uses, and spatially-defined concessions can be awarded for installations using any of the three mentioned energy technologies.\(^83\) The Decree also creates an exclusive zone for “the transport of electricity”\(^84\) adjacent to this energy zone. Finally, the Decree creates two zones for energy storage installations.\(^85\) Safety zones are declared to ensure that energy operations are not disturbed by fishing and other activities.\(^86\) The zoning plan also recognizes the dynamic nature of the marine environment and, for that reason, the Decree requires a revision of the zoning plan to be conducted every six years.\(^87\)

The approach of China, which has considerable experience with spatial management and MSP, is similar to that of Belgium. In China, the area-based approach is a substantial element in promoting the ocean economy\(^88\) and local regulations must conform to the preemptive national zoning law.\(^90\)

China’s National Marine Functional Zoning (2011–2020)\(^91\) divides China’s territorial waters and EEZ into zones. These zones are also divided into eight different categories, depending on the main activity to be developed within the zone. These include mineral and energy, fisheries, aquaculture, ports, industrial and urbanization, tourism, or environmental preservation. The Plan aims to develop the ocean economy through mariculture and energy investments and also provides special protection for biodiversity areas by creating preservation zones to restore 2,000 km of coastline.\(^92\)

All proposed activities that will use ocean space need to be in compliance with Marine Functional Zoning. ORE projects must be proposed only in the pre-selected zones for energy development, and projects funded at least in part by the government benefit from a streamlined

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\(^83\) Royal Decree at art. 8 § 2
\(^84\) Id., at §3.
\(^85\) Id. at §4.
\(^86\) Id. at §5.
\(^87\) Id. at 6.
\(^89\) Jay et al., *supra* note 82, at 175.
\(^90\) Id.
\(^92\) Id.
permitting process.\textsuperscript{93} Despite its advantages, the Marine Zoning Plan has been criticized for its lack of adequate environmental assessments and procedures for the engagement of stakeholders.\textsuperscript{94}

The spatial plan established by the Belgian Decree functions to coordinate policies administered by the government. The MSP implemented through the Decree does not affect the existing competences and regulations of other federal agencies or regional governing bodies.\textsuperscript{95} Zoning has led, for instance, to slight adjustments of vessel traffic routes, which is allowed at designated passages through the energy zone.\textsuperscript{96} Historical analyses of vessel data show how shipping traffic has gradually adapted to the construction of new offshore wind installations in the area.\textsuperscript{97} Finally, the long-term strategic planning provided by the MSP regulation allows for advance planning for transboundary grid connection, as well as integration within the broader framework of the European electricity grid.\textsuperscript{98} The Decree was complemented by governmental objectives that set specific targets to develop the entire renewable energy zone by 2020. This is regarded as proof of governmental support and provides increased legal certainty for ocean energy investors.\textsuperscript{99}

However, other experience shows the potential limitations of the spatial approach. In the UK, the first round of bids for offshore wind projects was launched in December 2000. No spatial management was employed at this point. Instead, the developers suggested the project locations. All winning projects were relatively small-scale (no more than 30 wind turbine generators as required by the bid), and most were able to complete their permitting process in less than 15 months.

In 2002, the government, following a different approach, asked the wind industry to provide information on potential wind energy sites. Based on that information, the government selected three areas for development. A tender process was conducted for these three areas in July 2003, and 15 projects were approved.

One of the purposes of the Energy Act, enacted in 2004, was to create REZs and to streamline the permitting process for ORE projects within those borders. On average, the licensing process for projects approved in the second round took longer to be completed. These delays have been attributed to the larger size of the projects (now full utility-scale) as well as to the increase in volume and detail of monitoring. More conflicting uses, navigation safety requirements, and designated MPAs also contributed to the delays.\textsuperscript{100}

\textsuperscript{93} OES supra note 9, at 41 and 47.
\textsuperscript{94} Jay et al., supra note 82, at 183.
\textsuperscript{95} OES, supra note 9, at 27.
\textsuperscript{96} Id. at 50.
\textsuperscript{97} Id.
\textsuperscript{98} For example, the Belgian plan recognizes the proximity of ocean energy zones in neighbor UK waters. See Belgian Ministry of the Environment, supra note 88, at 23.
\textsuperscript{100} Renewable UK, supra note 78, at 32.
Finally, the third bid for offshore wind projects was conducted in 2009, and new zones were proposed after conducting a marine spatial planning process. However, studies show that the new spatial-based regulation did not significantly improve the length of time required to complete the permitting process.\footnote{Id.} One explanation is that the delays are not attributable to the creation of zones, but to other legal requirements introduced in the same law, such as extensive consultation and additional technical requirements.\footnote{Overall, Stakeholders consulted in the UK considered that the regulatory framework for ORE development had improved with the spatial-management approach, that the process was easier to understand than before, and that the new approach reflected decisive policy support for the deployment of utility scale projects. See Renewable UK, supra note 78, at 33-34.} Also, the further offshore a proposed project is located, the less information on the marine environment is available, which increases the length and complexity of the Environmental Impact Assessment (EIA).\footnote{Id. at 3.}

c. Regulating technological innovation. Pilot ORE projects.

The previous paragraphs have discussed regulation for the deployment of large-scale ORE projects under the bottom-up and the top-down approaches. However, entrepreneurs seeking to test new energy devices operate under very different circumstances. The purpose of this section is to assess how the bottom-up and the top-down approaches regulate small-scale or pilot ORE projects. Regulation can encourage or hinder technological advancement, especially relevant to the development of renewable energy technologies at sea.

Technology research on land can occur both in public and private spaces; in many cases, private corporations are likely leaders in the technological advances. At sea, however, the situation is completely different. The sea itself and seabed spaces are not divided into private and public property. These areas belong to countries under national sovereignty. Government agencies are entrusted with the task of managing uses of the nation’s sea spaces. Accordingly, regulatory decisions have a direct impact on technological research.

There are different regulatory needs for different ORE technologies. Offshore wind developers have achieved significant technical advances and are ready to develop large-scale projects. Wave and tidal energy technologies, on the other hand, are unlikely to reach utility-scale maturity before the end of this decade.\footnote{See OES, supra note 43, at 33.} Developers of hydrokinetic energy are most interested in rights to test sites, because their main interest lies in developing a resilient, efficient, and financially competitive device. Tidal energy projects need leases over the seabed where tidal turbines are to be installed, but many other activities may be conducted in the same marine area without affecting energy generation. Wave energy converters and floating wind turbines also need the assurance that other activities on the water column and the surface will be limited or forbidden.

Despite their differences in terms of needs and objectives, ORE developers researching current, wave, and tidal energy technologies confront a similar challenge: these technologies are
yet unproven. In order to obtain the necessary financial and governmental support they need to undertake large-scale commercial projects, these technologies need to prove that they are viable options for energy production. New devices need to be tested in appropriate locations to obtain information on their potential, as well as to increase the level of information on their environmental impact.

i. Permitting for pilot-projects under the “bottom-up” approach.

While offshore wind provides a good example of the regulatory hurdles for utility-scale energy developments offshore, other less developed ORE technologies, such as wave and tidal energy, provide examples of the difficulties associated with the allocation of ocean space for small-scale, pilot projects to demonstrate technology.

The regulatory approach to hydrokinetic energy in the U.S. illustrates this situation. Tidal and wave energy generation in the US is limited to just a few pilot projects, and even in those cases, regulatory procedures have delayed research projects for several years.

Several federal, state and tribal agencies have jurisdiction over tidal energy projects.105 The siting of a tidal energy project is likely to affect hydropower regulation, ‘water quality and in-water discharges, state and federal lands located beneath the sea, coastal resources and marine sanctuaries, underwater and other cultural resources, shipping and navigation, crabbing and fishing, endangered and threatened species, marine mammals, migratory birds and seabirds, and recreation and public safety.’106 The foregoing list is not exhaustive. The installation of a pilot project involving a single device is a daunting experience for developers.

The Rivers and Harbors Act (RHA), as amended by the Outer Continental Shelf Lands Act (OCSLA), gave the US Army Corps of Engineers (USCoE) jurisdiction to issue permits concerning construction of any “obstruction” on US navigable waters, as well as in the outer continental shelf (OCS).107 USCoE is also the federal agency in charge of issuing Section 404 permits under the Clean Water Act.108

In order to increase legal certainty, the Energy Policy Act of 2005 (EPAct) established the authority of the Secretary of the Interior over “easements, leases, and rights-of-way”.109 The Secretary has delegated this power to DOI’s Mineral Management Service. In 2010, in the wake of allegations of unpreparedness and agency capture,110 the Management Service was renamed as Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), later divided into the Bureau of Safety and Environmental Enforcement (BSEE) and the Bureau of Energy

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105 Marriott et al., supra note 57, at 1.
106 Id.
110 The circumstances associated with the 2010 Deepwater Horizon accident in the Gulf of Mexico are out of the scope of this paper. For a detailed explanation of the operational and regulatory problems identified with offshore oil and gas exploration and the role of the Minerals Management Service, see Alyson Flournoy et al., Regulatory Blowout: How Regulatory Failures Made the BP Disaster Possible, and How the System Can Be Fixed to Avoid a Recurrence, Center For Progressive Reform White Paper 1007 (2010), at 21.
Management (BOEM). BOEM now has jurisdiction to regulate offshore energy projects in the OCS under Section 388 of EPAct. However, several other federal agencies retain jurisdiction over energy projects.

The Federal Power Act gives Federal Energy Regulatory Commission (FERC) authority to issue licenses “for the purpose of constructing, operating, and maintaining dams, water conduits, reservoirs, power houses, transmission lines and other project works” in US navigable waters. FERC asserts that its authority over navigable waters includes the territorial sea and the continental shelf.

With both DOI and FERC have asserted jurisdiction over the same marine energy projects, the conflict was partially resolved in 2008, when the two agencies issued a joint Memorandum of Understanding (MoU). However, developers still need to fulfill the permitting requirements established by both agencies.

ii. Permitting pilot projects under the top-down approach: permanent test zones.

By contrast to the bottom-up approach, nations following the top-down approach have addressed the need for adequate testing sites for ORE research by creating permanent test sites. This approach offers the advantage of a geographically-defined area of marine space that is to be exclusively used for testing wave, tidal, or current energy designs.

Examples of this top-down approach to management of pilot projects can be found in the UK, Portugal, Spain, among other countries.

In the year 2003, the British Parliament created the European Marine Energy Centre (EMEC) See Figure 8.

Fig. 8

111 16 USC § 797. General Powers of Commission. See also Showalter, Supra note 51, at ii.
Special regulatory conditions are granted to pilot projects for renewable energy research in a spatially-defined marine area off the coast of the Orkney Islands. One of the main features of EMEC is that developers seeking to test their devices in EMEC-administered waters do not need to apply to government agencies for permits and leases. Instead, they are required to submit an application explaining the characteristics of their project directly to the EMEC Board of Directors. Once an application for a pilot project is accepted, the developer may use EMEC’s installations at no cost during a certain period of time, and with no need for additional regulatory procedures.

The EMEC Research Center has been instrumental in wave and tidal energy research, facilitating the development of turbines and devices of ventures such as OpenHydro or Pelamis. EMEC has recently extended its research to the socioeconomic conditions of ORE development, exploring opportunities for collaboration between renewable energy entrepreneurs and small-scale fishers.

Portugal provides another example of a spatially-defined test area. Administered by the Portuguese corporation ENONDAS, Ocean Plug (Figure 9) is a wave and wind demonstration site off the coast of Marinha Grande in Leiria, Portugal.

Fig. 9

The Plug was created by a decision of the executive power (Cabinet Resolution 163/2006) with the aim of creating “an industrial cluster associated with wave power” and promoting research and development of ocean renewable energy technologies. It later was established by law. Ocean Plug is administered by a public utility, which oversees the regulatory requirements of the proposed pilot projects in the zone. Ocean Plug is a real “testing zone” created by a law enacted by the Portuguese Parliament which allows developers to use the facilities at no additional cost.

The Biscay Marine Energy Platform (BIMEP) (Figure 10) is a similar initiative for a marine energy test site funded by the European Commission’s Framework Programme 7 (2007-2013) under the MARINET initiative.

Fig. 10

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Still under construction, BIMEP will provide infrastructure for research and demonstration of wave energy converters. The BIMEP test site, like the Ocean Plug test site, will also provide connection to the grid. The creation of the BIMEP “test zone” was an initiative of a local government (Basque Country). For its creation, BIMEP developers had to comply with all regulatory requirements of the “bottom-up” approach. In the case of BIMEP, it will be a local government, not a specialized institution, which centralizes the regulatory requirements for testing devices within the zone.

Regulatory initiatives to promote ORE testing have taken different stacks. The UK enacted a law creating the EMEC Research Center and providing it with facilities and funding. Portugal issued a regulation creating a “testing zone” and transferred regulatory competences to a public utility. Portugal also required that the testing zone be made available to the international community of ocean energy developers. In Spain, the Basque Country, a local authority, joined with Tecnalia, a private entity, to create a testing site and to oversee its regulation.

d. Comparing the top-down and bottom-up approaches.

There are shared challenges with the bottom-up approach to allocating ocean spaces for ORE. Since there are no priority areas for ORE, developers, researchers and utility companies send their proposals independently and without knowledge of the government plans and priorities for that area. As a result, the risk of projects and permits being denied is higher. Also, since new activities such as ORE production need to share a limited sea space with many other uses, there is a higher risk of conflicts between uses and users. ORE developers, as “newcomers” are at a disadvantage with respect to other traditional users of the seas, such as industrial fishers, merchant shipping companies, or oil and gas producers. Traditional users have the advantages of experience, a better knowledge of the practices, priorities, and procedures of government agencies, and are therefore more apt to benefit from agency capture.

Consideration of the environmental impact is also limited. Most coastal states have enacted regulations that require an environmental impact assessment (EIA) of all major economic activities that may have a negative impact on the environment. Under the bottom-up approach, after a developer has applied for a permit for an ORE development, the government agency, during the permitting process, will require an EIA. However, as has been explained, i.e., by Kiesecker et
one of the most significant limitations of the EIA process lies in the difficulty to take full account of the cumulative impact of human activities on the environment. The problem, which affects both users and regulators, is aggravated by the special characteristics of the marine environment: different activities are carried on at the same time in the same area, with little or no close monitoring. An EIA performed on a case-by-case or project-by-project basis can underestimate the actual impact of the proposed activity on other activities and on the environment. Developers of ORE are not in the best position to assess the effects of their relatively new uses on the marine environment and its biodiversity. In addition, the fact that developers act independently makes coordination between identical or very similar activities more difficult. For example, ORE developers acting independently will likely spend more money in basic infrastructure, e.g., cable mooring, grid connection, energy storage facilities, or port infrastructure for maintenance operations.

In the bottom-up approach, developers need to comply independently with all regulatory requirements for permits and leases to government-owned submerged lands and marine areas. In the top-down approach, environmental compliance review is often streamlined due to the existence of programmatic EIS for “renewable energy” zones, saving some steps in the regulatory process for all projects planned within the zones.

<table>
<thead>
<tr>
<th>Table 1. Comparison between the bottom-up and the top-down approaches</th>
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<tr>
<td><strong>BOTTOM-UP REGULATION</strong></td>
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<tr>
<td>(Non-spatial management)</td>
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<tr>
<td>User initiative to select sites</td>
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<td>No incentives to group projects in the same area</td>
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<tr>
<td>Regulatory compliance is carried out agency by agency</td>
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<tr>
<td>Real estate for onshore facilities is an independent process</td>
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<tr>
<td>No special process for considering potential conflicting uses</td>
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<td>Limited legal certainty</td>
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116 Joseph M. Kiesecker et al., Development by design: blending landscape-level planning with the mitigation hierarchy 8 FRONTIERS ECOL. & ENVIRONMENT 261 (2010).
118 Kiesecker et al., supra note 116, at 261.
May use adaptive management

Implements adaptive management

In the bottom-up approach, developers need to deal with local communities on a case-by-case basis to obtain property rights to real estate and rights-of-way for power cables where their onshore facilities will be located. In the area-based management model, rights-of-way for cable lines are usually planned at the same time as the marine zones. Certainty on where the energy projects will be located allows several energy developers to combine their efforts and use the same marine power transmission cables. The same can be said of the necessary onshore facilities or substations: government support by the declaration of specific “ORE zones” also means that efforts towards offshore-to-onshore connection will be streamlined.

Under top-down area-based management, developers have more legal certainty and are in a better position to make good decisions. In the traditional bottom-up situation, developers apply for leases, pressured by competition and uncertainty, without having sufficient information concerning the technical and environmental conditions in the area, or their ability to connect the project to the electricity grid. They are more likely to enter into leases and agreements before determining that the project is feasible. Developers then try to lease as much marine space / seabed as possible because they do not really know what will be the final location of the project. This situation is more likely to lead to conflicts with other uses, since other users may see that the energy developers are taking too much space.

ORE technologies depend on specific environmental and/or geographical conditions to develop their full potential. Under the bottom-up management model, developers have no control over human activities being performed in the surrounding marine area. However, some actions can have a negative impact on energy generation. If an oil platform is installed near a tidal energy turbine or a wave energy farm, it may interfere with the marine current and the wave height, distorting the ability of the devices to generate electric energy. Conversely, under the area-based management approach, the zoning plan will have addressed these potential conflicts during the planning phase and will distribute zones for uses that have limited or no impact on each other.

Finally, under the top-down area-based approach, regulatory agencies are in a better position to implement adaptive management measures. Adaptive management “is a formal, systematic, and rigorous program of learning from the outcomes of management actions, accommodating change and improving management.” Under the traditional bottom-up approach, adaptive management might be applied, but the decisions on how to adapt to the conditions of the changing marine environment will be taken on an individual basis by each agency.

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119 This is the case of the MSP process in Belgium where all marine energy zones will share a unique and exclusive connection to the grid, known as the “plug at sea,” which is also designed as an energy storage facility. See Belgian Ministry of the Environment, supra note 88, at 8.  
120 See Jennie L. Bricket et al., Marine and Hydrokinetic Energy Lease Agreements, in THE LAW OF MARINE AND HYDROKINETIC ENERGY Ch.4 5 (2011)  
with the user. Area-based assessments on the other hand allow agencies to see the big picture, considering how neighboring uses are affecting each other and the marine environment. The area-based approach supports a legal framework that is better prepared to adapt to uncertainty and change. Under the area-based approach, adaptive measures and mitigation actions can also be planned at a large scale.

Despite its limitations, the bottom-up approach also has some advantages. Under the bottom-up approach, the developer of ORE technologies has, at times, a higher degree of freedom to negotiate with other users of the seas. For example, entrepreneurs interested in testing tidal energy devices depend on their capacity to access a few, very specific locations where tides are strong. It is possible that, under the top-down management model, several of these locations would not be declared “ocean energy zones.” However, under the bottom-up approach the developers can directly engage the local communities and relevant stakeholders and negotiate with regional authorities to put their devices in the water. This was the process that led to the installation of the first grid-connected tidal energy turbine in the U.S. at Cobscook Bay in 2013.122

Overall, the top-down area-based approach to ORE regulation is proving appropriate for promoting the construction of utility-scale renewable energy projects without undermining other sea uses and the protection of the marine environment.

IV. Lessons learned for the future development of ORE regulation.

As the previous sections show, countries have developed disparate regulations for ORE development.

Diverse and inconsistent regulatory approaches are not surprising in a new area of the law. Just as most ORE technologies are still in a research and development phase, so too is the legal framework to regulate them. Research and innovation in this field is not the exclusive realm of engineers. Regulatory innovation is an imperative for the effective management of new economic activities at sea, such as ORE investments. This is particularly true in the case of human actions taking place in the vast spaces of territorial seas and the EEZ, where monitoring and enforcement activities are especially challenging.

Predicting how the legal framework for ocean resources management will evolve in coming years is a debatable exercise. It is possible, however, to at least summarize a few requirements an effective “law of ORE” should meet.

First, ORE regulation must be capable of managing several simultaneous large-scale renewable energy projects in a manner that allows them to be completed without significant delays with a long-term perspective. This means that regulation must be able not only to effectively manage current developments, but also to provide a long-term vision of the development of human uses at sea that will allow ORE developers and other users to plan accordingly.

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Second, regulation must ensure that these ORE projects do not negatively interfere with each other or with the marine environment, avoiding major conflicts between users. This is particularly true today, when there is increasing concern on the need to protect marine life and the overall environmental health of the oceans.

Third, regulation for ORE must provide certainty to investors on the most pressing issues in the planning and construction of an ORE development. These include confidence in ownership of the seabed and/or sea area to be occupied by the project, streamlining the permitting process, and assurances that the project will be connected promptly to the electricity grid.

In order to assess how the ORE regulatory picture may look in the next decade, it is useful to have a look at other cases where regulators have implemented a top-down area-based management approach for large-scale renewable energy projects. Utility-scale solar energy projects on public lands in the American Southwest provide an example of a successful top-down area-based management approach.

The 1978 Public Utility Regulatory Policy Act (PURPA) encouraged investments in renewable energy projects. The statute required public utilities to purchase electricity from private facilities at a cost equal to what it would have cost the facility to produce that energy itself. Despite the significant support PURPA provided for renewable energy research, only a few large-scale and grid connected projects were developed in the following two decades. Besides the technical difficulties that are to be expected in a new technology, utility-scale solar energy projects require large tracts of land for development. There are few such large tracts available on private lands.

Renewable energy developers viewed the availability of space on public lands as a significant advantage for large scale solar energy development. However, the Bureau of Land Management (BLM), the agency of the Department of the Interior (DoI) in charge of managing public lands, has a broad mandate to make public lands available for a variety of uses, ranging from recreation and wildlife protection to cattle grazing and mineral extraction. In other words, the BLM has a broad mandate for managing public lands that encourages allowing multiple uses at the same time in the same area. A large-scale solar energy facility constitutes a use of the public lands that is incompatible with most other uses. In most cases the approval of large-scale solar energy projects would conflict with other, already approved, uses.

In 2005 Congress enacted the EPAct, establishing specific targets for renewable energy. Among other measures, the EPAct established specific renewable energy targets. It imposed on BLM the duty to approve non-hydroelectric renewable energy projects on public lands “with a generation capacity of at least 10,000 megawatts of electricity” by 2015.\(^{123}\)\(^{124}\)

This ambitious target led to sweeping regulatory reforms by the DOI. The BLM was in need of a regulatory framework that would allow it to streamline its permitting process for


renewable energy projects while, at the same time, balancing other uses of public lands and maintaining required protections for wildlife and the environment.

In 2010, the BLM turned to an area-based management approach in the form of a Draft Programmatic Environmental Impact Statement (PEIS) for solar energy development in public lands. The PEIS is a form of environmental assessment that allows regulatory agencies to evaluate the environmental impact of proposed activities that present similar characteristics, employ similar technologies, and/or that occur in the same geographic location. The Draft PEIS introduced an area-based assessment of solar energy development, stating that the definitive PEIS should identify three types of zones: a) areas to be excluded from solar energy development, b) priority areas for solar energy, and c) areas suitable for mitigation actions.

In 2012, the U.S. Bureau of Land Management (BLM) approved its definitive PEIS, which constituted a new Solar Energy Program (SEP) for six Southwestern States: Arizona, California, Colorado, Nevada, New Mexico, and Utah. The assessments for the solar PEIS led to the identification of 19 Solar Energy Zones (SEZs). In these SEZs, solar energy projects were to be prioritized and streamlined.

Based on the information obtained, the BLM prioritized investments in those areas by following some planning criteria, balancing the most suitability for energy production and the least landscape and environmental impact. First, the BLM promotes the development of large scale investments in areas of low ecological interest, or at least in areas where the environmental impact of those investments can be compensated through mitigation measures. At the same time, the BLM declared several areas of high ecological value as zones to be avoided by renewable energy developers. For example, SEZs cannot be located in the habitat of threatened or endangered species. Second, priority was given to energy developments that proposed to be installed in land areas already degraded by previous activities—commonly known as “brownfields”, such as those affected by intensive farming, or industrial and public landfills.

In essence, the PEIS constituted an exception to the general rule of multiple-use management of public lands. The solar PEIS found guidance in contemporary theories of land use and landscape-level planning. The latter shares many principles with area-based ocean

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125 See 40 CFR 1502.4(b) and (c)
128 See e.g. Secretary Jewell Underscores Importance of Landscape-Level Approach, Mitigation in Meeting President’s Renewable Energy Goals on Public Lands, http://www.blm.gov/wo/st/en/info/newsroom/2013/august/NR_08_13_2013.html (last visited March 20th, 2015). Land use planning has been defined as “[t]he process by which decisions are made on future land uses over extended periods of time that are deemed to best serve the general welfare”. Land use management evaluates the characteristics of the land, the resources it contains, and the interactions between the environment and human population. As a result of this assessment, government agencies detailed information on how human
management theory, and its application to the development of renewable energy provides some lessons for ORE regulation. Both seek to organize human activities in large geographic areas in a way that minimizes their impact on the environment. Both provide long-term planning and goals, and both provide incentives for proposed projects in the areas that have been spatially defined to be used for renewable energy generation.

The BLM’s SEZ initiative has proved to be successful for renewable energy development. As of September 2014, 13 utility-scale projects had already been approved under the requirements established in the PEIS and are under construction stage within the solar zones. The BLM is on its way to meet President Obama’s 2020 goal.

V. Conclusions.

Significant efforts will be required to ensure human development without further damaging our planet. Promoting new renewable sources of energy constitutes a key strategy if the nations of the world desire to ensure that progress in human development is not trumped by catastrophic climate change.

ORE technologies are at a tipping point in their progress from concept to maturity. Technological breakthroughs are expected in deep-water offshore wind, and wave and tidal energy by the end of the present decade. These advances will reduce costs and allow for the construction of utility-scale projects. The potential of these energy technologies combined is enough to satisfy the world’s energy demand.

Regulators do not patent new inventions or come up with ideas to trigger technological advancement, but they have a critical role in ensuring the necessary transition in energy development. Inadequate regulations are a significant hurdle to technological innovation and to the introduction of new uses of the seas. Engineers devising new mechanisms and designs to generate ORE need to be paired with like-minded ocean management regulators open to experiment with new legal approaches. Regulatory innovation in ocean management is needed for several reasons.

First, as the most recent IPCC Report shows, the window of opportunity for taking effective action to mitigate climate change is closing. At the same time, every day a human being is deprived of his or her most basic needs, such as adequate food, health or security is an affront to humanity as a whole. Transition to clean energy is a key strategy to confront both global challenges, and when technical feasibility for large-scale ORE developments becomes a reality, ocean management regulators need to be prepared to seize the opportunity.

activities impact the environment. This is also true for proposed renewable energy developments, where their environmental impacts may not have been fully explored.

129 2 in Arizona, 8 in California, and 3 in Nevada.

Second, if ORE developers do not have an adequate regulatory framework for testing their devices, or if the availability of space for testing prototype devices or installing pilot projects is extremely limited and trumped by a mind-numbing regulatory process, technological progress will lag and investors will seek for other opportunities.

Finally, the always increasing number of activities and uses performed at sea demands new regulatory ideas on how to perform complex, simultaneous management of ORE projects without gravely disrupting the marine environment or other ocean-related economic activities.

Nations interested in developing their ORE potential can learn from the history of regulatory reform in countries such as the UK, Belgium, or China, as well as from the development of utility-scale solar projects in federal lands in the American Southwest. They can take steps to develop an area-based legal framework for ocean resources that is adequate to promote these renewable sources of energy, while at the same time balancing the interests of ORE investors, other sea users, and protection of the environment.